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ASSESSING THE ROLE OF ENVIRONMENTAL, ECONOMIC AND HOUSING CONDITIONS IN MALARIA PREVALENCE: A CASE OF MUBARAKPUR, PAKISTAN

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ABSTRACT

Like many other less developed areas of the world, malaria is one of the major health concerns of Pakistan, particularly widely prevalent in rural areas. In these areas poverty, low level of awareness, environmental degradation, poor housing conditions and insufficient health facilities are considered to be the main contributing factors spreading malaria. This micro-level evaluation study is aimed at to assess the role of environmental, economic and housing conditions in the prevalence of malaria in Mubarakpur, a rural area located in the Bahawalpur district of Pakistan. The research has been carried out using primary and secondary data. Primary data was collected through questionnaire using random sampling method and directly interviewing the local community members. It has been found that warmer summer and humid monsoon season, poverty, poor housing conditions, poor sewerage system and improper waste disposal system are the main factors of malaria prevalence in the study area. The study reached the conclusion that poor housing conditions, unhygienic surrounding environment, poor sewerage system and improper solid waste disposal system of the study area provide encouraging environment and favorable habitat for the spread of vector diseases like malaria. Thus, by improving hygienic and housing conditions and properly disposing solid and liquid wastes, the incidence of disease can be minimized in the study area.

KEY WORDS: Environmental conditions, Economic conditions, Housing conditions, Malaria prevalence, Mubarakpur,

INTRODUCTION

Malaria is not a new disease and has been in lime light since long. During the twentieth century it was the most sever and complicated health issue fronting the humanity. At that time it was affecting an estimated 300 million people and causing more than a million deaths per year worldwide (WHO 2000). Despite many new inventions and improvements in medical science of today, it is still believed that malaria is a major killer of mankind and is responsible for 300 to 500 million clinical cases and 1.5 to 2.7 million deaths per year (WHO 1993). About 270 million new cases of malaria are recorded every year of which 95% are reported from less developed areas having poor hygienic conditions like Mubarakpur village of Bahawalpur district in Pakistan. Although geographic environment is considered to be a major reason, however economic and housing conditions may also play vital role in the spread of this disease (Mankodi 1996). The relative role of such factors in the spread of malaria, however, may vary notably through

time and space. It is thus, required to deal the areas on individual basis while working on the factors of malaria. Likewise, the spatial study in point is based on similar idea and explores the main causes of malaria at micro level in a specific area. Even though, incessant efforts to eradicate malaria transmission have been made, the incidence in some parts of the world is reported to be increasing every year including the study area. As it falls among the leading causes of human deaths in the world over having countless psychological, economic and medical impacts, henceforth, it is the need of the time to pin-point the actual causes involved in its increasing level (Devi and Jauhari 2013).

At official level Pakistan is categorized as a country where malaria prevalence is at moderate level along with comparatively reliable malaria control measures. Even then millions of lives are threatened here by this disease. About half a million malaria cases are reported annually in Pakistan out of which at least 50,000 people die of this disease (Yasinzai and Kakarsulemankhel 2009). Conversely, some studies indicate that malaria is quite common in Pakistan and its infection is highly endemic (Khan et al. 2013). It is one of the main community health issues of Pakistan where malarial species Plasmodium vivax and Plasmodium falciparum are widespread (Jamil and Khan 2012). In complicated and sever vivax and falciparum malaria cases, the death rates are further raised due to lack of awareness and inefficient management of patients. In 2008, according to official health statistics, 4.5 million suspected malaria cases were registered in Pakistan. It was 16% of all out door attendances at basic health units, where the number of confirmed cases of malaria during this period were 104,454 of which 30% were infected by Plasmodium (Yasinzai and Kakar 2012). Nevertheless, occurrence of malaria depends on a complex and dynamic web of factors including the behavior of mosquitoes and people, land-cover and land-use, housing quality, and health system strength (WHO 2014, Jackson 2003). Like other less developed countries, most of the villages in Pakistan have no proper drainage system and no facilities to dispose-off their wastes. Such factors may cause malaria in Pakistan (Soomro et al. 2010, Barat et al. 2004). It is a common belief that in any area, the nature of socio-economic and environmental conditions influences the rate of prevalence of both infectious and non-infectious diseases. Poor socio-economic and unhygienic environmental conditions provide ideal conditions for the spread of harmful vectors like mosquitos. Several studies reveal that spread of malaria is strongly associated with deprived socio-economic and poor environmental conditions (Alemu et al. 2011, Aggrey and Douglason 2010, Mankodi 1996, Cohen, Wilson and Aiello 2007, Asghar, Attique and Urooj 2009). The area focused in current study is not an exception and it is one of the rural areas of Bahawalpur

district of the Punjab province where almost similar situation prevails. Although, in such areas of Pakistan malaria is a foremost common health issue since long, but during rainy season and during floods, problem is further aggravated (Khan 2010).

Numerous researches have been conducted to find out the factors associated with malaria at individual and household level also. But all the studies do not succeed to find out the real causes of both individual and household level due to the wide range of their potential factors (Worrall, Basu and Hanson 2003, Soomro et al. 2010, Shuja et al. 2016, Raut 2004, Pemunta 2013). However, it has been established that malaria is one of the top five causes of deaths occurring worldwide annually. In the world over, this health issue is most commonly prevalent in less develop areas. For instance, in Africa, it is widely prevalent in south of the Sahara because this region offers ideal conditions for spread of disease like household farming, poverty, and poor malaria control programs (Ringler 2012). Similarly, the economic activities in which the people of frontier areas of South East Asia are engaged also contribute partially to the spread of malaria where the disease has high resistance against the use of malaria drugs (Hazra, Tripathi and Alam 2000). Socio-economic conditions are considered to have an influence on human health and may include high growth rate of population, increasing rate of unemployment, high dependency ratio, low literacy rates, large family size and high room density (Park, 2009). Poor socio-economic conditions, poor knowledge and low level of awareness about malaria and anti-malarial strategies have collectively contributed in the prevalence of malaria in many parts of Pakistan also. These factors effect physical and social environment responsible for mosquito breeding. Several studies have revealed that poor socio-economic conditions and unhygienic living conditions provide conducive environment for the occurrence of disease.

This study is aimed at to assess the role of environmental, economic and housing conditions in the spread of malaria in Mubarakpur. This rural area of Pakistan lies in sub-tropical region and belongs to agrarian society where majority of population is poor. Several factors are contributing to the spread of malaria in this area in which environmental degradation, poverty, poor housing conditions and increasing resistance of disease against accessible anti-malarial medicines like chloroquine are most important. A continuous decline in vector diseases control activities and their transmission is further supported by warm autumns in this region. Improper irrigation system and inadequate dumping of waste and garbage further facilitates the spread of the disease. The seasonal precipitation specially the monsoon along with extensive irrigation network add fuel to

the fire by creating favorable conditions for mosquito breeding places over all in entire Pakistan (Abeku et al. 2003) and specifically in study area.

STUDY AREA AND METHODOLOGY

For this particular study, the localities of Union Council Mubarakpur were selected due to having fragile environmental and socio-economic conditions that are considered to be working as the driving forces for malaria prevalence. Geographically, Mubarakpur is located at 29.3° N latitude and 71.6° E longitude in Bahawalpur plain on southern side of Sutlej River. It is situated at a distance of about 40 km from Bahawalpur City on its south western side (figure 1). The national highway and main railway line running from Peshawar to Karachi are located very near to it passing from its southern and northern sides respectively. It lies almost at half way between Peshawar and Karachi. It is counted among the populous and famous settlements of Ahmmadpur East Tehsil of Bahawalpur district. According to the Tehsil Municipal Committee of Ahmadpur East, total area of Union Council Mubarakpur is 3652 acres and estimated population is 46917 persons. The density of population is 12.84 persons per acre. It comprises of five Mauzas namely Mubarakpur, Ghulamali Channar, Mangloti, Mahi Tibba and Anwar Abad (figure 2). Almost all the area is arable where wheat, cotton, sugarcane and vegetables are commonly grown which are usually sold in nearby markets of Bahawalpur and Ahmedpur cities. However, per acre crop production differ significantly throughout the region due to variations in soil and ground water quality. Although most of the houses are made up of bricks but some mud houses are also found. Most of the houses are simple and open where the level of

cleanliness is poor.

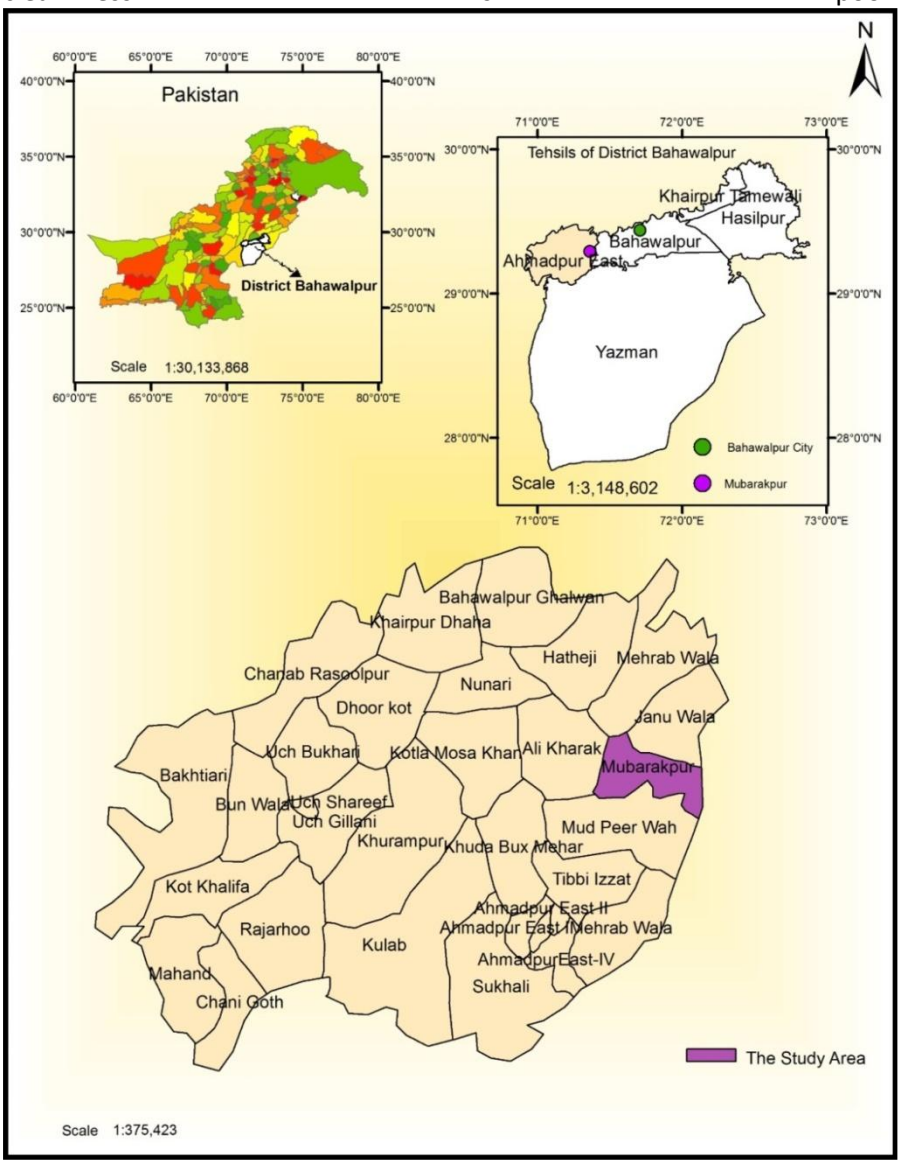

Figure 1: Location of the study area in Pakistan, Bahawalpur district and Ahmedpur East tehsil

Some households are involved in domestication of animals also, where both humans and animals are accommodated at the same place. Most of the streets are unpaved where waste water flows in open drains and its considerable fraction is soaked into the ground. On reaching to underground water table it is polluting aquifers which are the main source drinking water in the area. Literacy rate and level of education is low and most of the population consists of red-collar workers mainly engaged in

agricultural pursuits. Education and health facilities are not well developed and awareness about hygienic conditions among the people is noticeably low. Summer season is considerably severe and during summer nights most of the people sleep in courtyards without any protective measure like mosquito nets and exposed to the attack of disease.

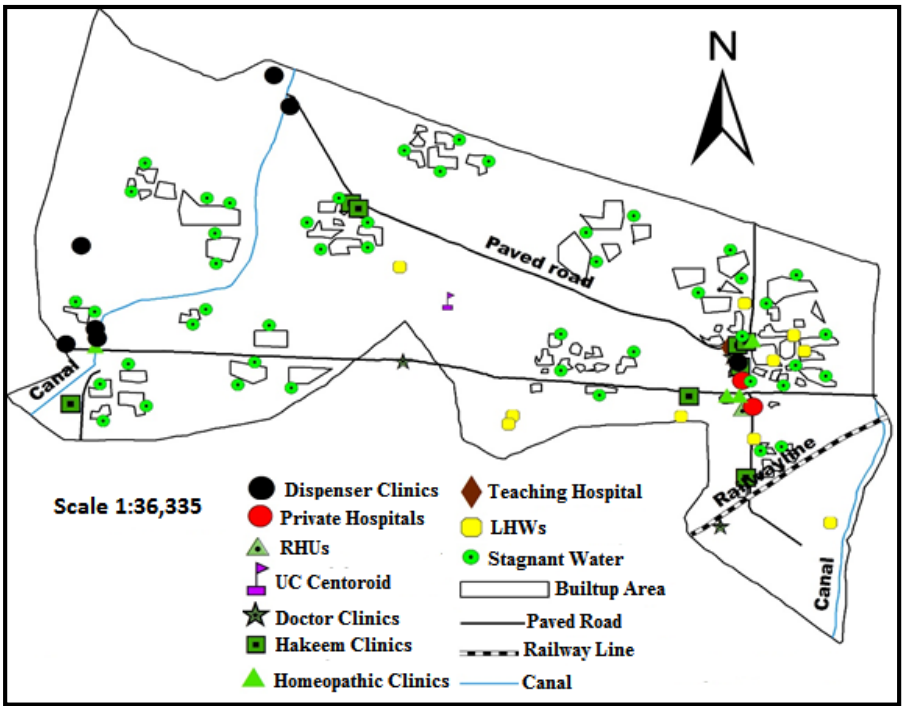

Figure 2: Mubarakpur: the study area

To assess the role of environmental, economic and housing conditions of the area in the prevalence of malaria, both primary and secondary data were used. Secondary information was gathered from various concerned offices like Union Council Mubarakpur, Municipal Committee of Ahmedpur East as well as from census reports, internet sources and articles. Some basic information was also collected from topographic and other maps of the area. Primary data was collected using questionnaire through the field survey of randomly selected households of Mubarakpur. Only three mauzas out of six from the union council Mubarakpur were selected for survey where the total number of houses was 2152, the total population was 15,064 persons and the average household size was seven. A sample size of 300 houses (14% of total houses) was taken where almost 600 malaria cases were recorded that happened during different periods of time. The questionnaire used for the study included questions about various aspects environmental, economic and housing conditions of the

area. Besides this, some information was recorded from direct field observation, for example the attitude of people, condition of streets and neighborhood environment of sample unit (house), etc. For this purpose a separate field diary was maintained. Numerous breading places of mosquitoes were also observed and pointed out in the study area during field survey. After the data collection process was over, data processing and arrangement was completed to draw and present the results in the form of percentages, tables and graphs that have been given and discussed in the sections to follow.

FACTORS OF MALARIA PREVALENCE IN MUBARAKPUR

Though there are many factors responsible for the prevalence of malarial in the study area, but the role of environmental, economic and housing conditions appears to be dominating one. An assessment of the role of these factors in spread of malaria in Mubarakpur has been made below;

Environmental conditions

Although the term environment refers to all the external factors including living and nonliving, material and nonmaterial things which surround and influence humans, but this section accounts for only those environmental conditions which are the main determinants of malaria in the study area. According to recent concept, environment consists of not only the water, air and soil which are its main components but also includes the socio-economic conditions beneath which people live (Park 2009). The surrounding environment in which humans live may affect their health. For instance, poor housing conditions, work station, the poor quality of air that many people inhale, use of contaminated water, and poor sanitation may have adverse impact on human health. It has been mentioned in the several studies that behavioral designs of the vector, environmental factors and the host factors work together and provide an ideal ground for malaria transmission (Khan 2010). Malaria has strong association with climatic and seasonal variations. Changing thermal trend, humidity and precipitation can thoroughly affect the spread of malaria (Rema Dev 1999, Guthmann et al 2002, Devi and Jauhari 2013). Thus, the climatic conditions work as an important driving force for the spread of malaria by influencing both malaria parasites and vectors directly or indirectly. Mean monthly temperature, rainfall and relative humidity conditions prevailed in study area during 2011-2014 are given in table 1 and figure 3.

Table 1: Temperature, rainfall and humidity conditions of study area

Month	2011			2012			2013			2014		
	T	R	H	T	R	H	T	R	H	T	R	H
Jan	11.2	0.0	69.9	12.6	0.0	64	13.0	0.0	66	12.4	0.0	67.3
Feb	17.7	0.0	72.0	14.3	0.0	64	16.0	6.0	74	15.1	1.0	67.0
March	22.4	0.0	55.8	21.2	0.0	51	23.0	1.0	61	20.6	3.0	62.1
April	27.2	0.0	44.2	27.4	0.0	51	28.0	0.0	44	27.7	1.0	46.7
May	34.3	0.0	38.7	33.3	0.0	34	34.0	0.0	35	31.5	1.0	45.1
June	35.6	0.0	46.3	34.7	0.0	49	35.0	3.0	51	35.4	1.0	46.5
July	34.1	0.0	56.2	34.7	0.0	53	35.0	0.0	57	34.0	1.0	58.6
Aug	32.0	3.0	68.0	32.5	1.0	63	32.0	3.0	68	32.5	1.0	59.9
Sep	29.8	3.0	73.3	29.8	2.0	70	31.0	0.0	63	30.2	2.0	64.7
Oct	26.6	0.0	57.3	25.0	0.0	59	28.0	0.0	61	26.1	0.0	62.7
Nov	22.7	0.0	62.3	19.0	0.0	60	20.0	0.0	58	19.8	0.0	56.7
Dec	14.0	0.0	58.9	14.0	0.0	65	15.0	0.0	71	10.0	0.0	70.0

Note: T = Mean temperature in ^{o}C, R = Rainfall in mm, H = Humidity (%).
Source: http://www.tutiempo.net/en/climate/bahawalpur/2011 2014/417000

Table 1 indicates temperature, rainfall and humidity conditions during study period. The epidemiology of malaria is affected by precipitation because stagnant water offers not only the appropriate aquatic conditions for the phases of the parasite's life cycle but also intensify the absolute moisture and the long life of the mature parasites. The epidemiology of vector borne diseases like malaria is directly affected by climatic variation (Weli 2015). Spread of malaria in the study area is largely seasonal and geographical as most of the recorded cases were affected severely by the disease during rainy season. Although, high temperature and precipitation are major causes for spreading of malaria (Martens et al 1995), but unusual rise in precipitation and maximum temperature has no positive relationship with the increase of malaria (Konradsen et al 2003).

Precipitation determines the spread of malaria by its impact on the parasite life span, whereas heat acts as a controlling power. Study of climatic factors indicates that there is no significant fluctuation in temperature and humidity from 2011 to 2014 but variations in the amount of rainfall are significant during this period. During the months of January and February 2013, there is an unexpected increase in rainfall (figure 3). In the study area during normal years, temperature remains high in May, June and July but the amount of precipitation reaches at its apex during July, August and September (figure3). Data indicates that most of the annual rainfall in this region occurs during the months of July, August and September when temperature starts decreasing providing encouraging conditions for mosquito breeding. Vector and parasite of malaria both are influenced by temperature that is why the epidemic of malaria shows strong seasonal association (Van Lieshout et al. 2004). Range of temperature can also be used as a tool to assess the possible distribution of parasites in study area where malaria usually outbreaks in rainy season.

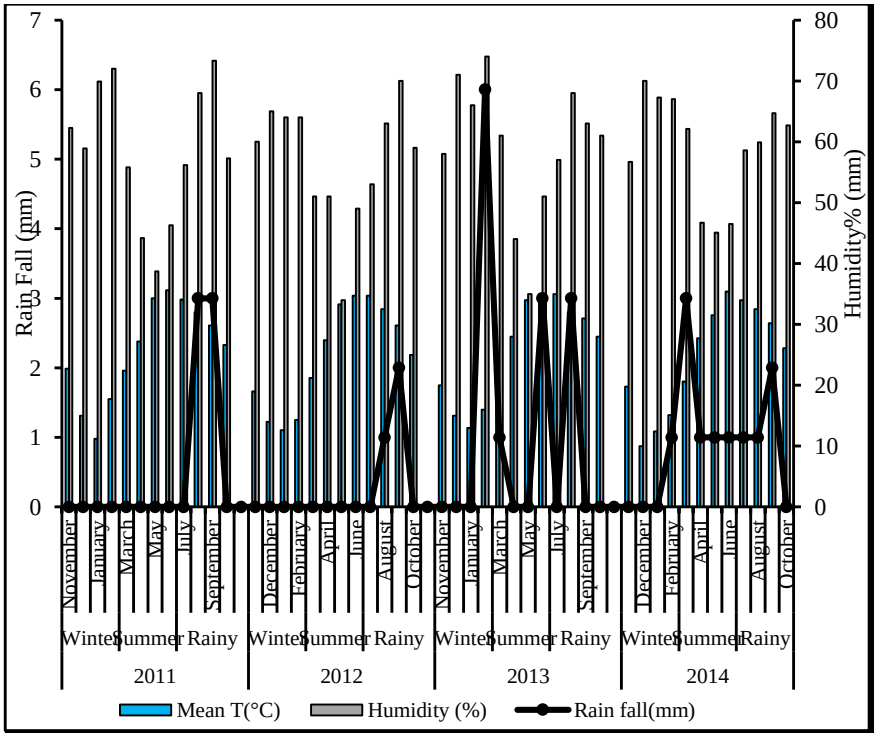

Figure 3: Temperature, rainfall and humidity conditions of study area

Economic and housing conditions

Economic conditions influence almost all the aspects of human life including housing conditions that are considered as one of the major determinant for the vulnerability of diseases. Poorly constructed houses with mud walls and thatched roofs are associated with higher risk of diseases. Well-constructed houses, made up of bricks and cement, are comparatively safer for the residents (Konradsen et al 2003). Poor environmental hygiene and housing situations may be a major risk dynamics for malaria parasite (Nkuo-Akenji et al 2008). Table 2 shows some of the major housing characteristics and surrounding environmental conditions in the in study area.

Table 2: Economic and housing conditions and malaria cases in Mubarakpur

01.	**Monthly household income (in Rs) and malaria cases**	**Number of houses**	**Percentage of houses**	**Malaria cases**	**Percentage of malaria cases**
	Up to 5,000	40	13.3	294	49.0
	5,001-10,000	90	30.0	126	21.0
	10,001-15,000	86	28.7	111	18.5
	15,001-20,000	50	16.7	50	8.3
	Above 20,000	34	11.3	19	3.2
02.	**Areas of house (in marlas) and malaria cases**				
	Below 5	147	49.0	419	69.8
	5-10	139	46.3	139	23.2
	11-15	12	4.0	30	5.0
	16-20	01	0.3	06	1.0
	Above 20	01	0.3	06	1.0
03.	**Building material of houses and malaria cases**				
	Cemented houses	177	59.0	204	34
	Mixed material houses	83	27.7	246	41
	Mud made houses	40	1.3	150	25
04.	**Solid waste disposal system of houses and malaria cases**				
	In streets	103	34.3	268	44.7
	In open plots	150	50.0	107	17.8
	Indoor dumping	47	15.7	225	37.5
05.	**Waste water disposal system of houses and malaria cases**				
	Open drains	78	26.0	271	45.2
	In streets	68	22.7	169	28.2
	In fields	71	23.6	50	8.3

	Pit drains	68	22.7	90	15.0
	Sewerage pipes	15	5.0	20	3.3
06.	**Surrounding environment of houses and malaria cases**				
	Vegetation cover	69	23.0	204	34.0
	Wood & straw heaps	54	18.0	138	23.0
	Dumping plot	48	16.0	132	22.0
	Stagnant water	18	6.0	102	17.0
	Others*	111	37.0	24	4.0
07.	**Sleeping habit of the household members and malaria cases**				
	Outdoor	260	86.7	481	80.2
	Indoor	40	13.3	119	19.8
Total households and malaria cases		300	100	600	100

**Note: ***Others include roads, buildings, empty spaces etc.

Family income and occurrence of malaria cases

People belonging to lower economic class are more susceptible to contamination and diseases as they are more likely to live in rural areas, in housing that compromises little safety against mosquitoes, and they are generally less likely to have access to protective actions such as insecticide treated nets (ITNs) or indoor residual spraying (IRS). They are also less likely to use health services which can offer active investigative analysis and cure (WHO, 2010). Table 2 and figure 4 show that only 11.3% households have monthly income above 20,000 per month. On the other hand 88.75% households are those having income less than 20,000 per month which is not sufficient to full fill household requirements. Among these 43.3% households are those whose monthly income is up to ten thousand rupees. This income is not sufficient to maintain a reasonable standard of living and to acquire safety measures against the disease. Therefore, highest number of malaria cases has been recorded in low income groups.

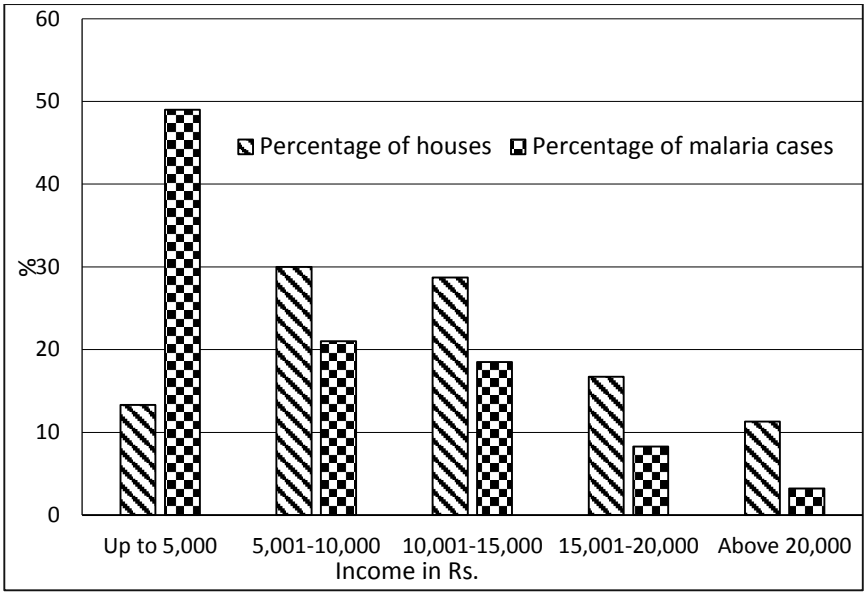

Figure 4: Monthly income of households and malaria cases

The analysis of household income reveals evidently that economically this area is deprived and poor. Low family income is an indirectly contributing factor for the spread of malaria in Mubarakpur. Almost half of the malaria patients belong to the houses having monthly income up to five thousand rupees per month and 96.8% cases were found in the households having monthly income up to 20,000 rupees per month. Poor people have more chances of exposure and to suffer from malaria because they cannot afford the cost of even basic needs like food and quality shelter due to low income (Biko et al. 2014, Barat et al. 2004). It is intrinsically hard for them to afford the cost of medicine and other protective measures against the disease. Furthermore, due to limited income, it is also not a priority of the people to spend some fraction of money on preventive and protective measures against the malaria.

Area of the house and occurrence of malaria cases

Small area of the house may have an adverse impact on the health of dwellers. Slightly less than half of the households (48 %) live in the houses having an area of less than five marlas (table 2). Over two third of the recorded malarial cases were found in this category (figure 5). Average room density is seven which is noticeably high. Another factor contributing to high frequency of malarial incidents in these houses was the practice of indoor livestock keeping. Overcrowding and poor hygienic conditions help out to make the transmission of malaria easy and from one individual to another as well.

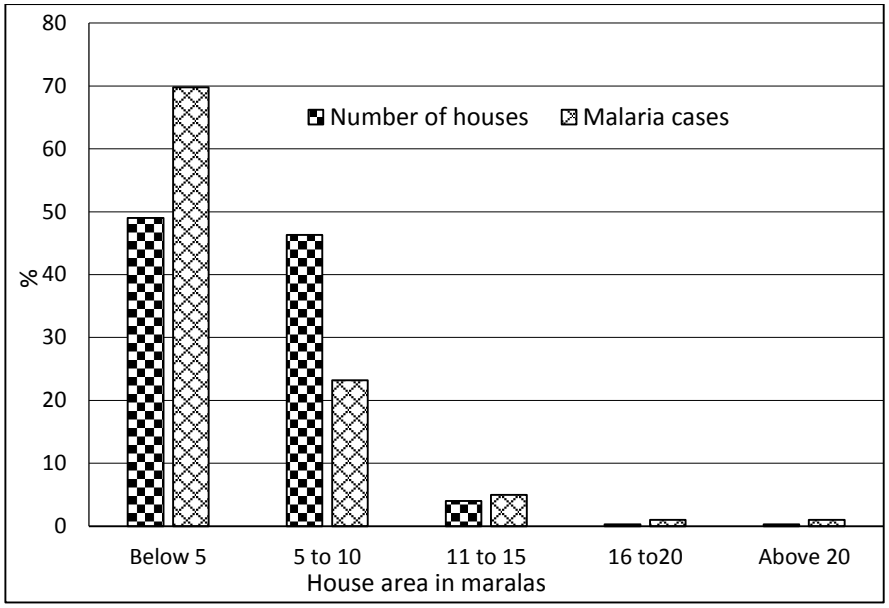

Figure 5: Area of houses and malaria cases

Building material of houses and occurrence of malaria cases

The role of this factor was also significant in the study area. Park (2009) mentioned in his book 'Preventive and Social Medicine' that malaria is associated with muddy houses as they provide favorable mosquito breeding places. Although majority of the houses were found to be made up of cemented material but it was also noted during the survey that roofs of many houses were thatched and work as breeding places for mosquitoes. It was found that incidence of malaria transmission is higher in the houses made up of mixed material than that of cemented houses because their roofs are thatched and walls are mud made which are difficult to repair and to maintain regularly (table 2). Due to such type of building material houses provide suitable conditions for mosquito breeding. The data indicates that 34% malaria cases are found in cemented houses, 41% in mixed material houses and 25% in mud houses (figure 6). Thus, the kind of building material may have a variable influence in the occurrence of disease. It was specifically noted that malaria parasite prevalence and parasite density was higher in the individuals living in wooden plank houses than that of those living in cemented and brick made houses.

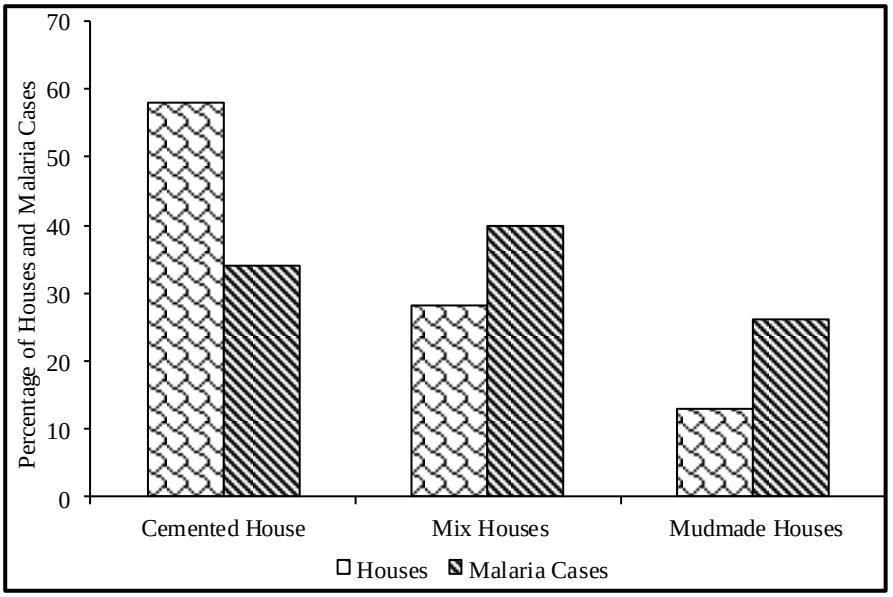

Figure 6: Building material and malaria cases

Solid waste disposal system and occurrence of malaria cases

The term solid waste include refuse, garbage, demolition products (like bricks, masonry, pipes etc.), sewerage treatment residue, dead animals, manure and other discarded material. If such waste it is accumulated in the streets and alongside the houses may become a health hazard. It decomposes slowly and favors mosquito breeding specifically in rainy season. It also invites rodents, insects and the pathogens which may nourish in the solid waste and can be carried out to human diet through insects and dirt and may cause health problems.

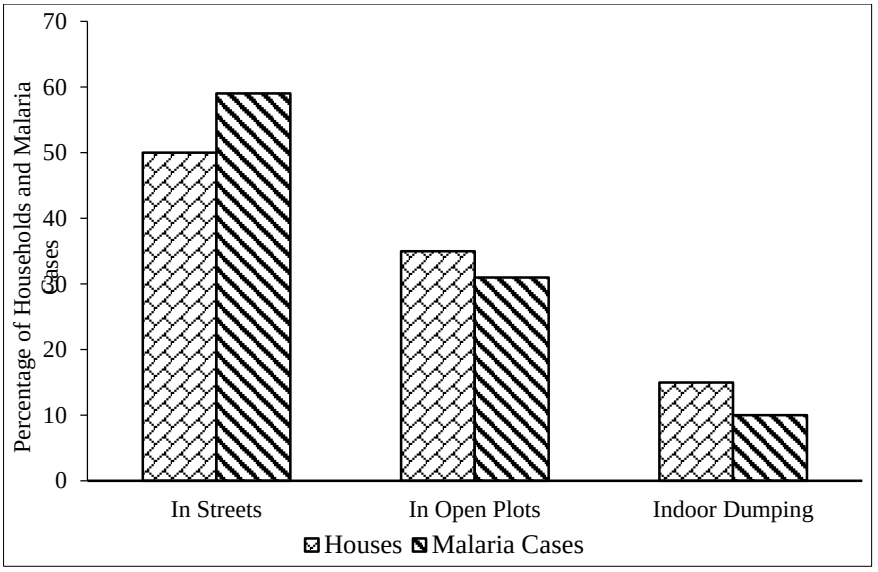

Figure 7: Solid waste disposal system of houses and malaria cases

Like many other rural areas of Pakistan, the study area has no proper system of solid waste collection, storage and disposal system. No containers for the collection of waste were found and people throw their solid waste in streets, in open places and dump in or outside the houses. It can also be a possible cause of the high rate of malaria prevalence in the study area. Although malaria cases have been recorded in all groups but it reveals from data that the incidence of disease is high in those houses which through solid waste in streets or in front of their residences (table 2). About 44.7% disease cases have been recorded in the houses that throw solid waste in streets, 17% in those which through it into open plots located at some distance from houses, and 37.5 in those which usually dump it within or along the houses (figure 7). Literature also reveals that there is a significant positive correlation between improper disposal of solid waste and incidence of vector borne diseases (Park 2009). Solid waste management is a serious issue of the study area which is one of the main causes the degradation of local environment and malaria prevalence.

Waste water disposal system and occurrence of malaria cases

It is commonly believed that release of untreated domestic waste water is multiplying water born diseases in many areas of Pakistan but deprived areas like Mubarakpur are comparatively more threatened. Absence of proper sewerage disposal system is creating several health issues in the area and spread of malaria is one of them. Excreta of houses and other liquid wastes are mainly released in to open drains, streets, pits or fields which provide favorable environment for mosquito breeding. Open drains

and sewerage released in to streets and open fields dominate on the scene. About 26% of the surveyed houses release their sewerage in to open drains, 22.7% leave it to flow in to the streets, 23.6% in to open fields and 22.7% in to pits (table 2). Only 5% houses were found to have some sort of piped sewerage. The number of malaria cases was highest in the houses using open drains for sewerage and then in the houses that leave it open in to streets (figure 8). Use of open drains and waste water running in to the streets appear to be the two major contributing factors of the malarial incidences in the Mubarakpur.

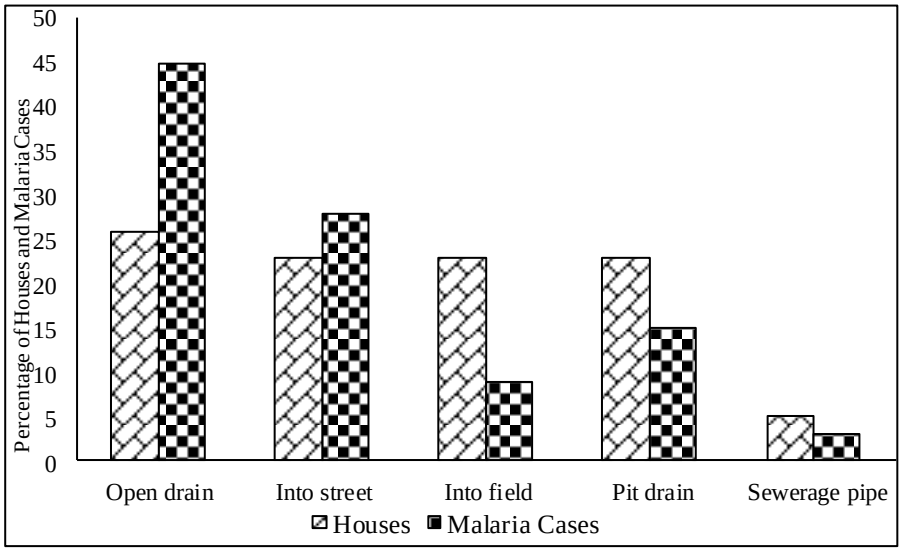

Figure 8: Waste water disposal system of houses and malaria cases

During survey, walking in streets was unpleasant because of the stinking air. Besides evaporation in to air, considerable fraction of sewerage water percolates in to the ground which is polluting aquifers the main source of drinking water in the region. Moreover, the liquid sewerage which is released in to the fields is used to irrigate fodder crops and vegetables that rapidly grow due the presence of high concentration of urea in this water. In so doing, some harmful chemicals, like detergents etc., present in this water may enter in to food chain and ultimately may reach to human and animal bodies. On bio-concentration in humans these chemicals may seriously harm them and weaken their body protective system against diseases making them more vulnerable to malaria. Unless effective measures are taken to provide proper means of sewerage disposal, the health issues like breeding of misquotes and flies, pollution of soil and drinking water, contamination of food, increase in the incidence of diseases, especially eccentric and helminthic diseases may become more serious.

Surrounding environment of houses and occurrence of malaria cases

Several factors are contributing to the spread of malaria in the study area and degraded environment is one of them. The things present in surroundings of houses greatly influence the occurrence of malaria. As things are always closely associated with each other and with their environment, a house cannot remain uninfluenced by its surroundings. In study area, people throw their wastes in open garbage depositing sites. There is no proper system to collect and dump the waste far away from the inhibited areas. Besides, people also prefer to plant trees in or along their houses for shelter and dump fire wood, cotton sticks and straw inside or around the houses. Inhabitants of houses surrounded by bushes, garbage heaps and swamps or stagnant water are more susceptible to malaria and thus showed higher rate of malaria prevalence compared to those having comparatively cleaner surroundings (Nkuo-Akenji et al. 2008).

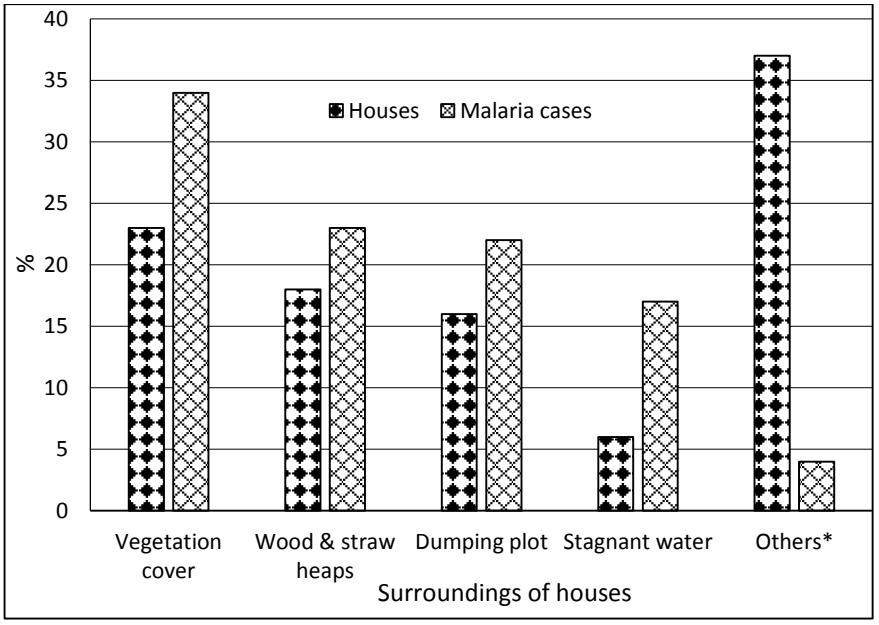

Figure 9: Surrounding environment of the houses and malaria cases
Note: *others include roads, buildings, empty spaces etc.

The majority of houses are agglomerated, bounded by other houses, streets and roads. Stagnant water, fire wood, straw, vegetation and dumping spaces were also observed alongside the houses. The isolated hamlet settlements were surrounded by agricultural fields, open sewerage water, trees and open air heaps of wastes. Relationship between housing adjacent environment and malaria prevalence showed that number of disease cases were high in the houses surrounded by vegetation cover

than compared to those surrounded by fire wood dumping spaces and stagnant water (table 2 & figure 9).

Sleeping habit and occurrence of malaria cases

Low resistance of human body against diseases, habit of outdoor or indoor sleeping, and less or no use of preventive measures are some of the host risk factors of malaria occurrence in this area. Due to prolonged and severe summers, load shedding of electricity and low accessibility to amenities of life, people are forced to sleep in courtyards or on the roofs of houses under the open sky providing easy exposure to mosquito bites. Data indicates that proportion of people having the habit of outdoor sleeping is considerably high (table 2). About 84% households told that they have the habit of outdoor sleeping in summer season while only 16 percent have the habit of indoor sleeping (figure 10).

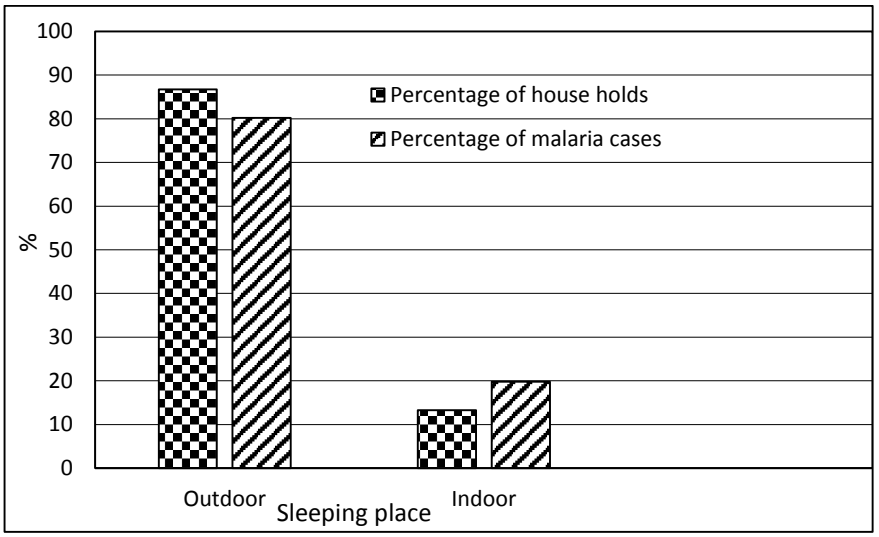

Figure 10: Sleeping place and malaria cases

Those who sleep outdoor are more vulnerable for malaria as they remain exposed to mosquitoes during whole night. Therefore, outdoor sleeping habit can be a possible cause of malaria spread. During field survey it was observed that fewer facilities and warm climatic conditions force the people to sleep outdoor. If the local government, district health offices, NGOs and other concerned departments provide some necessary instructions, financial support and protective measures (such as long lasting insecticide treated nets etc.) to the community, this problem can be solved to some extent. In this way mosquito bite chance may decrease and the disease may be eliminated from the study area.

CONCLUSION AND SUGGESTIONS

This study focusing on to the assessment of the role of various factors in malaria prevalence in rural area of Mubarakpur concludes that it is mainly a seasonal epidemic. In this area, the risk of malaria is associated with several interrelated factors, specifically to the climatic conditions and seasons of the year, economic conditions of the people and housing conditions like area of house, building material used, waste disposal system and surrounding environment. High temperature, poverty, the poor sanitary conditions, inappropriate sewerage and solid waste disposal system and poor health services supply system easily explain the high frequency of malaria cases in the study area.

The degrading environment has different dimensions of effects. Firstly, climatologically extremely high temperature in summer season and post rainy season are the significant contributing factors. Secondly, from the point of view of economic conditions, poverty is the main factor that contributes significantly in spreading this epidemic disease. Thirdly, the poor infrastructure, lack of services, inappropriate sewerage system, and inapt solid waste disposal system are also enhancing the vulnerability of residents towards the disease. Fourthly, the fragile environmental conditions of houses and encouraging surrounding environment are further fueling the issue.

Based on results and conclusion the study suggests that there are many environmental, logical and conceptual approaches to eradicate malaria. The conceptual frameworks approach can be used as one of the best supporting approaches for controlling malaria. According to this approach, the disease originated and supported by environment can be controlled or eradicated in three ways; first, by modifying the environment, second, by modifying the health services system, and third, by increasing malaria knowledge of the community inhabitants depending upon the epidemiological triad of that disease. First two methods can be applied on community level, environmental management level, municipal level and health care services level, while the third method is related to actions implemented on both domestic level and community level. Malaria eradication programs which highlight ecological management are very useful in decreasing illness and death rate due to this disease (Baerwald 2010). At domestic level there should be the use of insecticide nets, use of protective creams and lotions, proper sanitation especially managing waste and stagnant water, screening of houses, residual spray, protective clothing, proper ventilation and sunlight to discourage mosquito breeding. Health education and awareness among communities about family protection, residual spraying in housing colonies and collective

maintenance of immediate environment are the measures important at community level. Environmental management and municipal actions include measures pertaining to vector control than to reduce human vector contact. Moreover, inter sector coordination programs with agriculture and irrigation departments to control vectors of malaria can be supportive. Similarly, provision of relevant drugs and allocation of resources to malaria endemic areas is required from health care department.

Effective and efficient system of health care with sufficient local, national and international support can deliver best results to check malaria. Preventive measures to control malaria by early diagnosis and quick treatment can be helpful in this regard. Vector-control strategies also have a central role in checking the spread of disease and resulting mortalities. Prevention methods focus on the formation of a system to check the infection or defeat the advancement of the parasite after infection. Access to early diagnosis and rapid treatment with advanced ant-malarial drugs lessens the severity of the sickness, which finally reduces malarial mortalities (Noor et al. 2012). Beside these collective measures, one can also take individual step to check malaria by enhancing one's understanding about the causes, effects, preventive measures and treatment of malaria.

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